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CMMS Technical Framework

JSIMS Pre-Contract Award Briefing

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***Presented by
Jack Sheehan, CMMS Technical Director
DoD Modeling and Simulation Functional Data Administrator(FDAd)
Email: sheehan@arlut.utexas.edu
Phone: 703-998-0660 x287***



M&S Data Standards

DMSO is developing data standards to support three key modeling and simulation products:

- Conceptual Models of the Mission Space (CMMS),**
- the High Level Architecture (HLA), and**
- authoritative representations of environment, units and systems, and human behavior**

as directed in the DoD Modeling and Simulation Master Plan.



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This presentation describes...

DMSO sponsored integration of CMMS as a data engineering example:

- **the CMMS Technical Framework**
- **Implementation in the CMMS Prototype**
- **Integration with JSIMS/JWARS conceptual model development**



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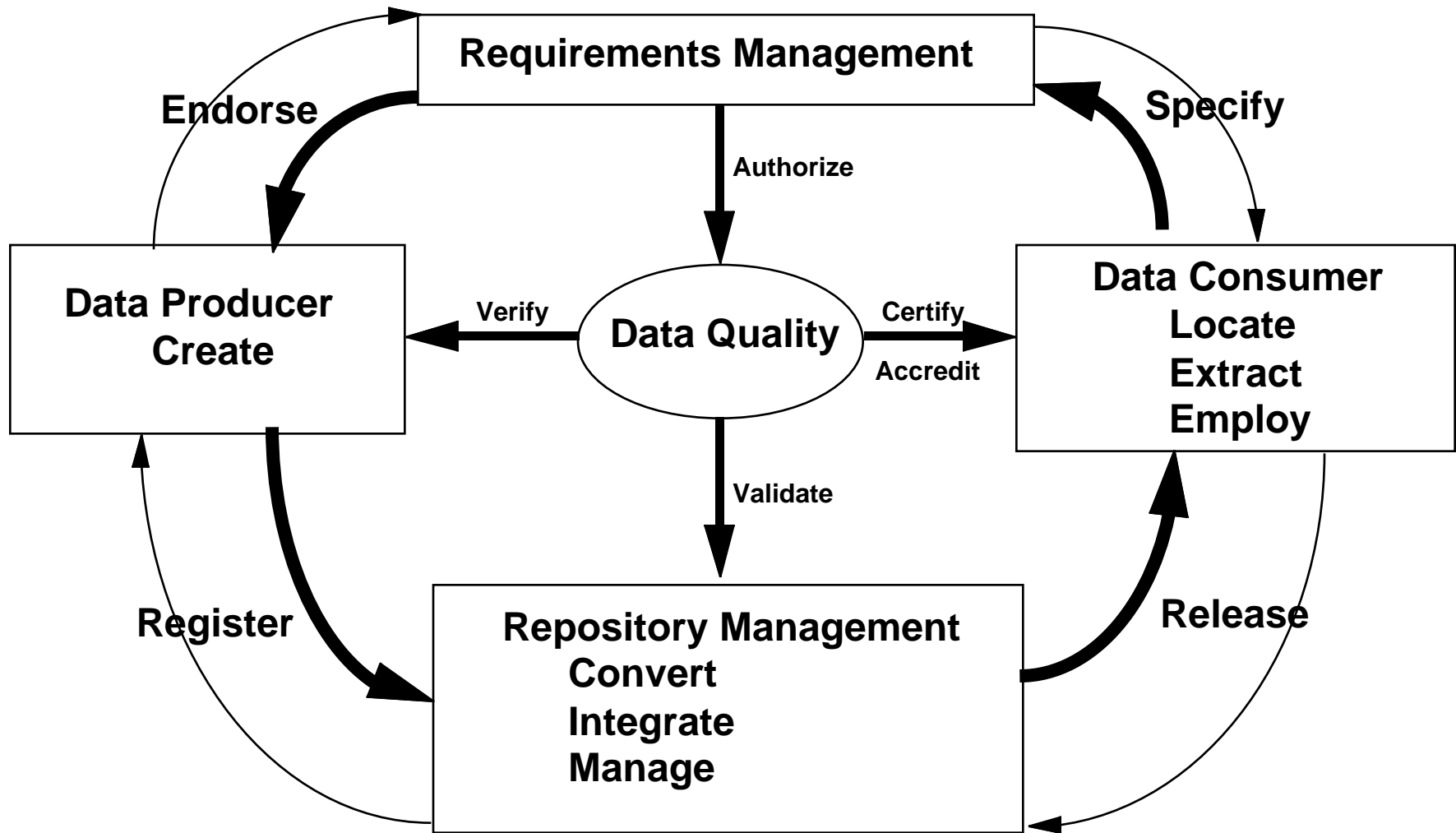
The companion DE presentation describes...

Data engineering to support CMMS, HLA, and authoritative representations:

- ☐ **the Data Engineering Technical Framework (DE TF)**
- ☐ **DMSO projects to demonstrate the DE TF**
- ☐ **DoD data standardization**



Data Engineering Process



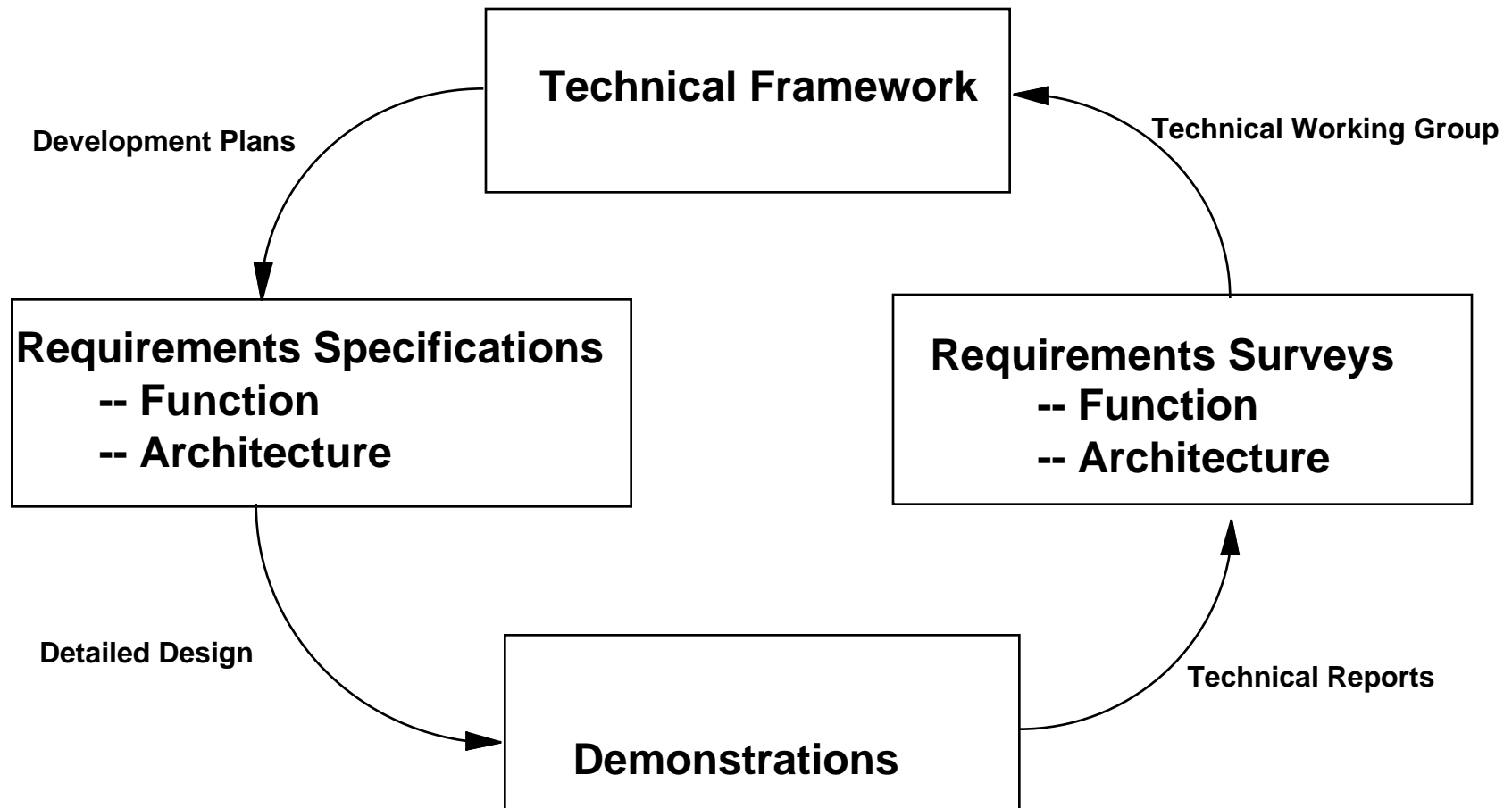
Primary Drivers (Deliver, Propose, Lead)

Secondary Feedback (Request, Review, Concur)



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CMMS Prototype Execution Process: (Two, Iterative 6-month Demonstration Cycles)





Conceptual Model of the Mission Space (CMMS) Technical Framework

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CMMS is a Rigorous Specification of Military Operations which are

- ☐ **Derived from Authoritative Data Sources**
- ☐ **Described Using Common Syntax and Semantics**
- ☐ **Independent of any Particular Simulation Implementation**

CMMS will Provide:

- ☐ **Conversion, Integration, Storage, and Extraction via DIF**
- ☐ **Physical Access and Logical Connectivity via MSRR**
- ☐ **A number of Structured Views for Display and Manipulation**
- ☐ **EATI Content Spec is CASE Tool/Method Independent**



CMMS Technical Framework v 0.1.6

- ☐ **Reserve Word Definitions**
- ☐ **CMMS Process**
- ☐ **Authoritative Data Sources**
- ☐ **Authorized Data Consumers**
- ☐ **Common Syntax and Semantics**
- ☐ **Entities, Actions, Tasks, and Interactions representation**
- ☐ **Levels of Warfare Abstraction**



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Technical Framework v 0.1.6 ***Open Items***

- ☐ **DIF Data Structures**
- ☐ **MSRR Specifications**
- ☐ **Concrete Use-Cases**
- ☐ **Detailed Development Procedures**
- ☐ **Specific Compliance Requirements**
- ☐ **EATI definitions, especially *Task* and *Interaction***
- ☐ **Recursive Re-use, Levels of Warfare Abstraction**



Reserve Word Definitions

Model

A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Mission

A *Task* which is executed by an *Actor* to achieve a specific *Objective*. A *Mission* includes the specific entrance criteria and exit criteria which govern its initiation and termination as well as the specific measures of performance and effectiveness which indicate its relative success.

Mission Space

A set of *Missions* which share a common organizing principle, purpose, or feature.



Authoritative Data Source

Data Source is composed of:

- ☐ ***Sponsor***
- ☐ ***Producer***
- ☐ ***Production Pedigree***
- ☐ ***Data Item or Model***

Authoritative Data Sources is composed of:

- ☐ ***Sponsor***
- ☐ ***Examiner***
- ☐ ***Data Source***
- ☐ ***VV&A/C Pedigree***



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Authorized Data Consumer

Data Consumer is composed of:

- ☐ ***Sponsor***
- ☐ ***Consumer***
- ☐ ***Clearance***
- ☐ ***Access***
- ☐ ***Security Pedigree***

Authorized Data Consumer is Composed of:

- ☐ ***Authoritative Data Source***
- ☐ ***Data Consumer***
- ☐ ***Release Pedigree***



Common Syntax and Semantics

Semantic Components:

- ☐ ***Vocabulary***
- ☐ ***Sentence***
- ☐ ***Context***
- ☐ ***Relationship***
- ☐ ***Canonical Components***

Structural Maturity:

- ☐ ***Internal Knowledge***
- ☐ ***Persistent Natural Language***
- ☐ ***Fully Structured Views***
- ☐ ***Canonical Representations***

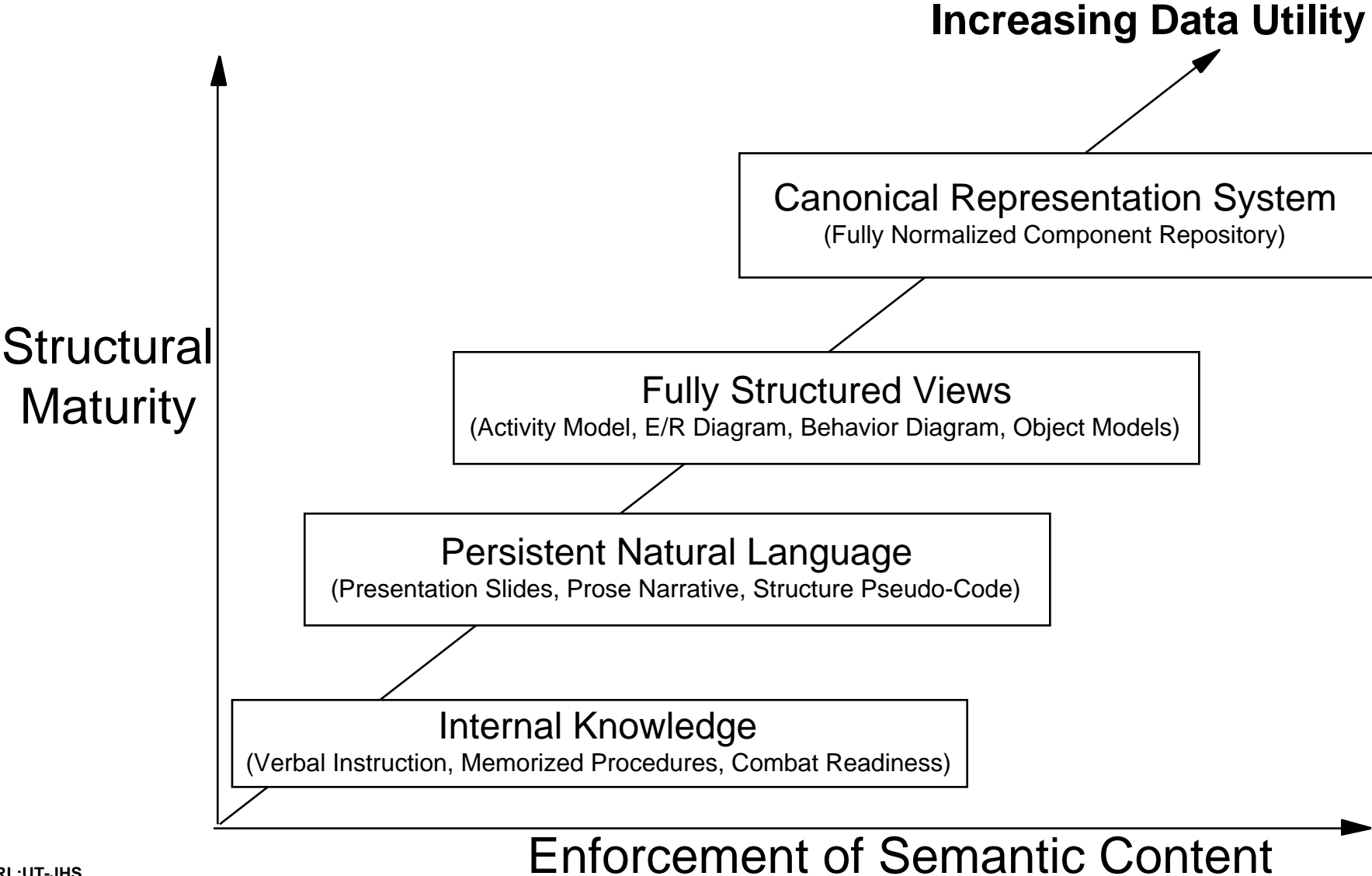


Units of Complete Behavior

Subject Matter	Pre-Condition	Transformation	Post-Condition	Canonical Triple
Military Operations	Actor	Action	Receiver	Task
Mathematics	Domain	Mapping	Range	Function
Computer Science	Input Data	Methods, State	Output Data	Object
Natural Language	Subject	Verb	Object	Sentence



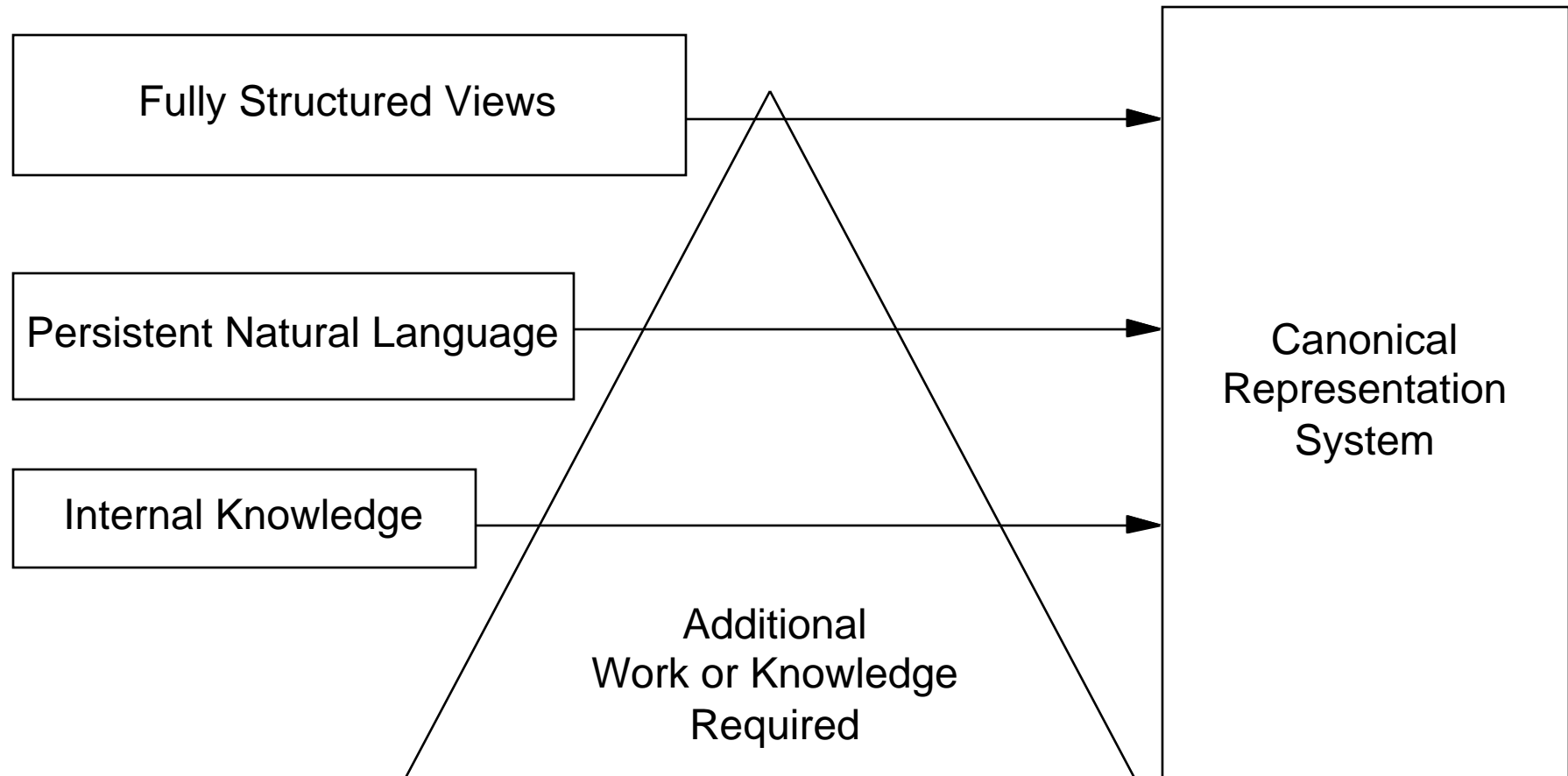
Mission Space Model Representation Dimensions





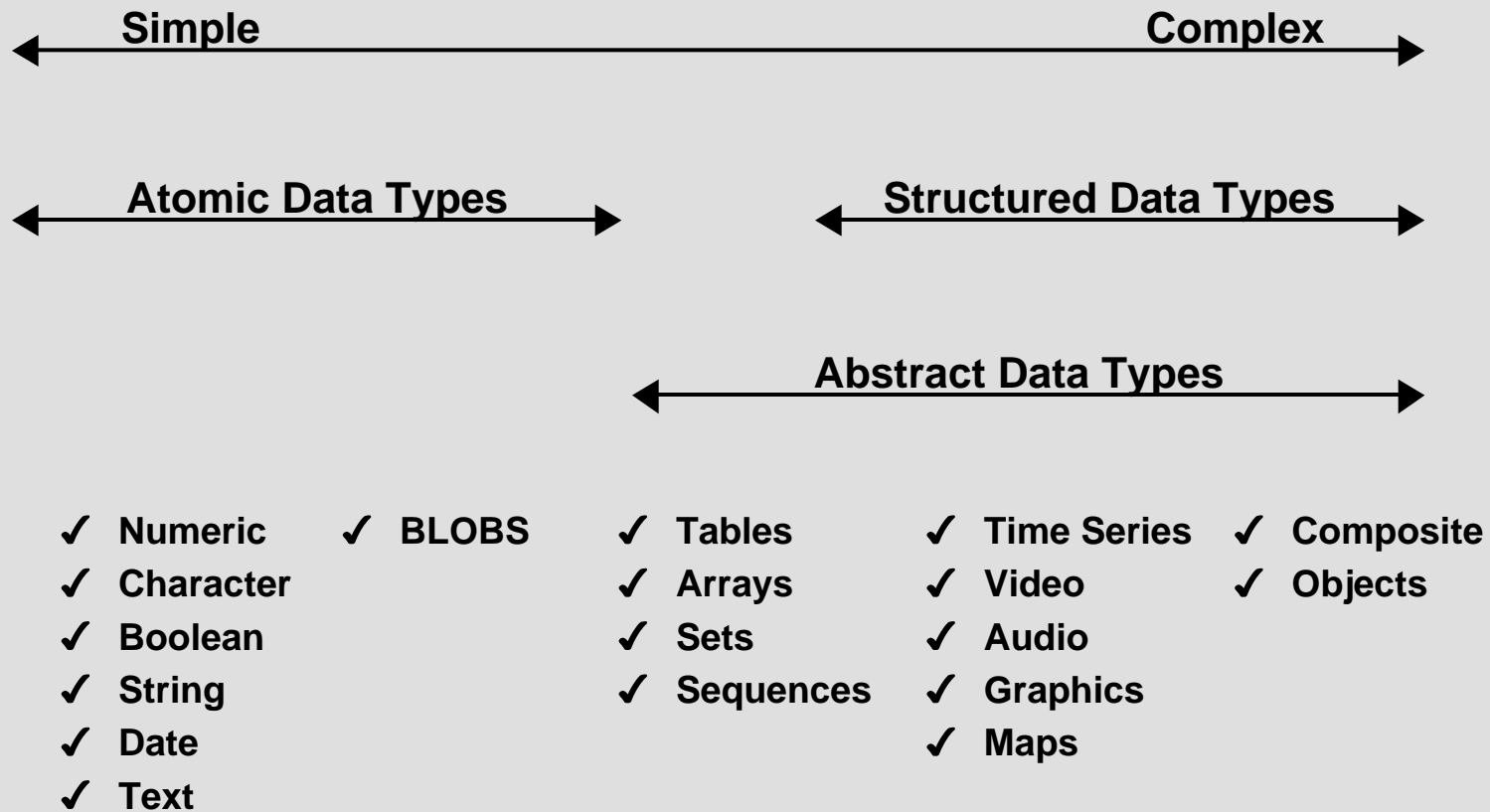
Migrating Mission Space Models at Multiple Levels of Structural Maturity

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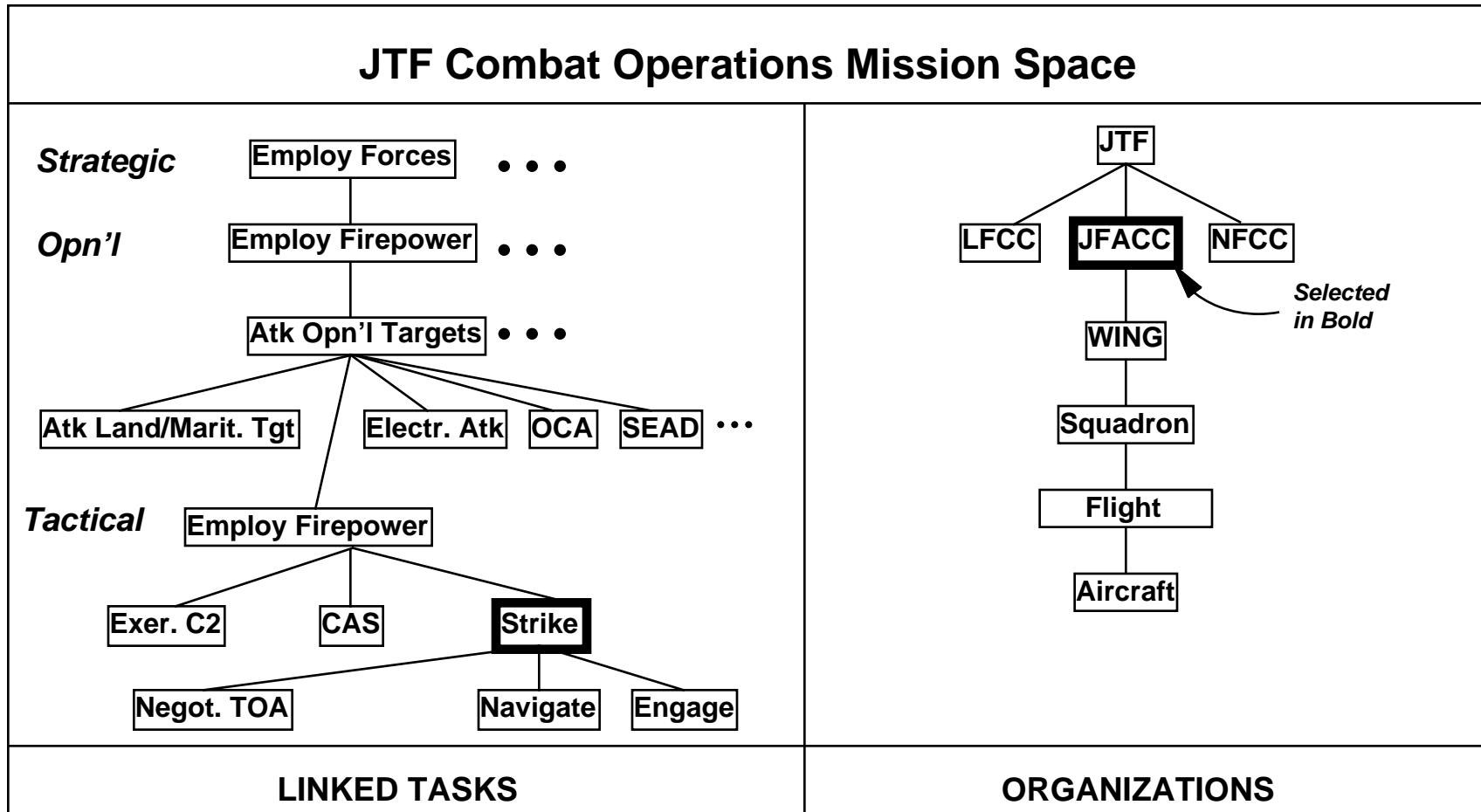
Data Types





CMMS Illustrative Example Interaction Selection Display

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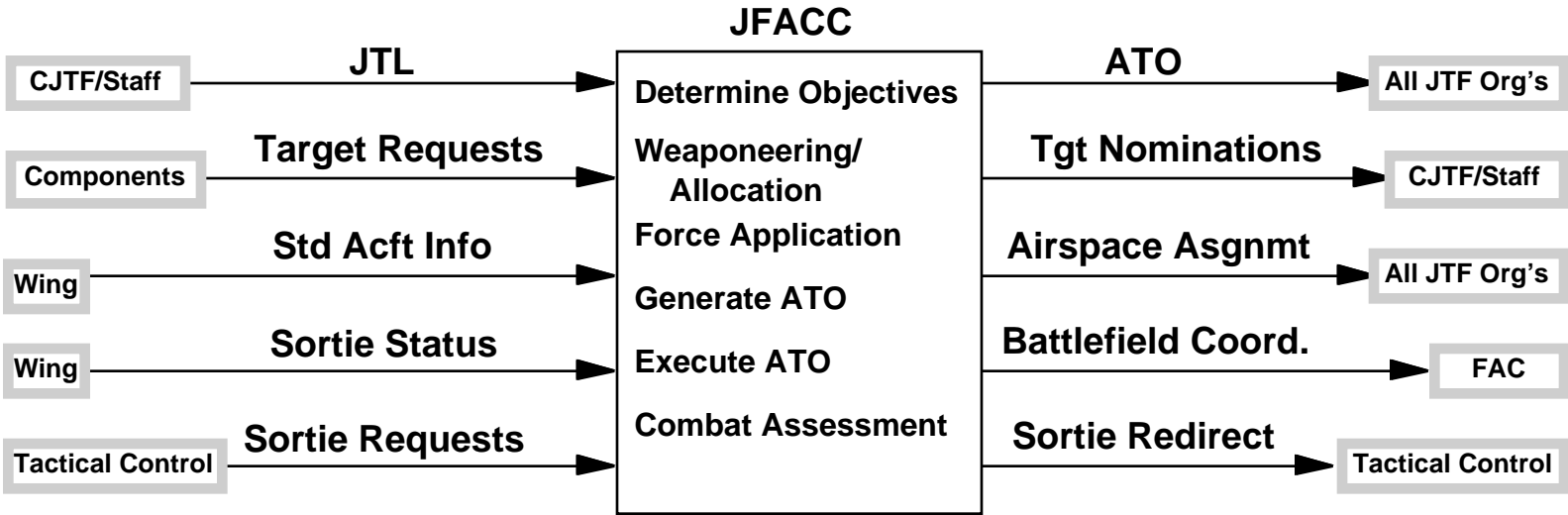
***User Selects Interactions Involved in
the Strike Task by the JFACC ...***



Illustrative Example

Interaction Display

JTF Combat Operations Mission Space

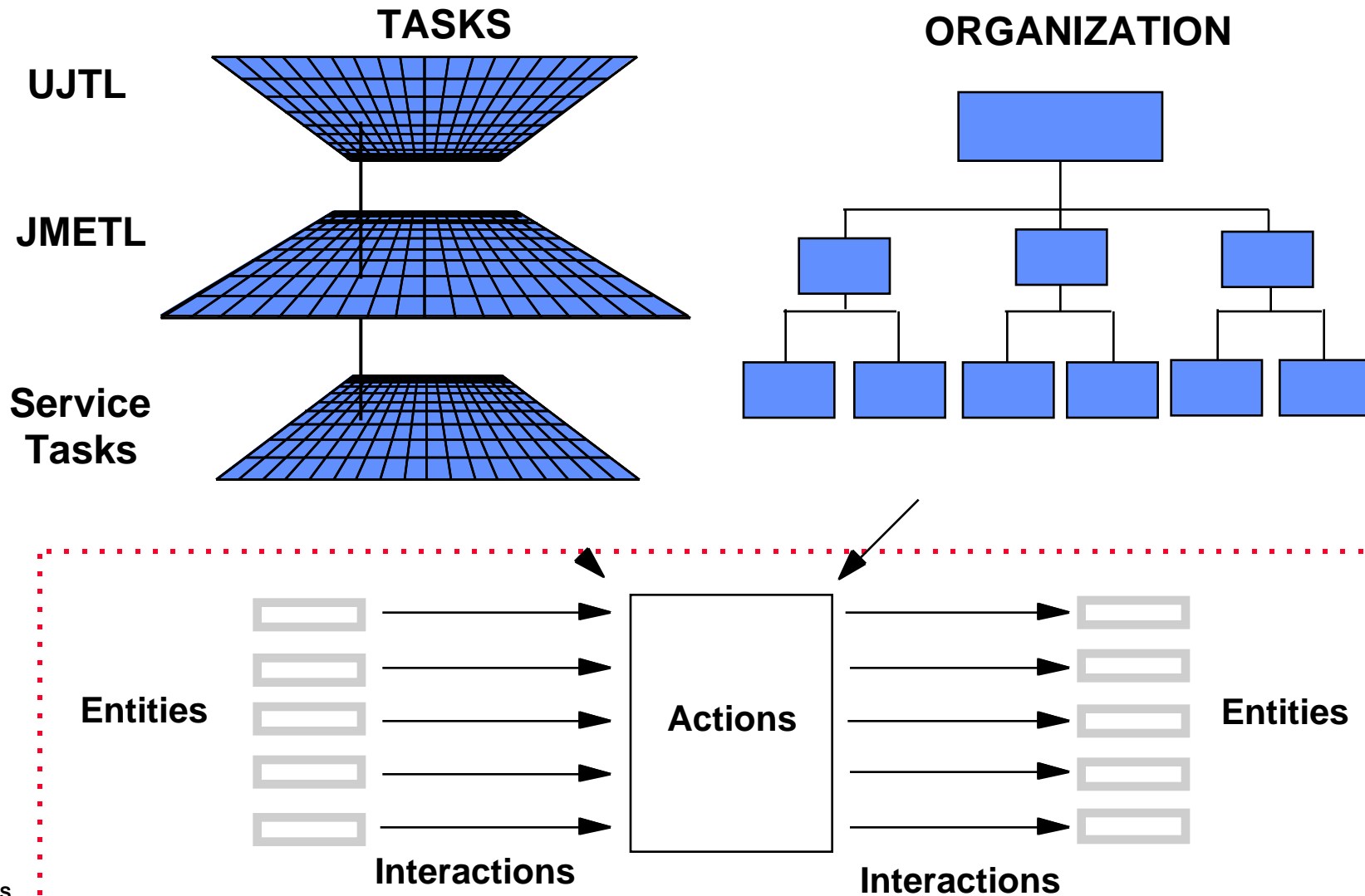


... Display Shows All Actions and Interactions for the Selection, in the Mission Space



Organizational Concept

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Entities, Actions, Tasks, Interactions: Basic Elements

<i>Entity</i>	A distinguishable person, place, thing, or concept about which information is kept [2]. In particular, <i>Entity</i> includes the notions of person, organization, facility, feature, materiel, and plan defined in [5].
<i>State</i>	An <i>Entity</i> attribute representing either an internal condition or an external environment.
<i>Event</i>	The location in space and time where a change in <i>State</i> or condition occurs.
<i>Action</i>	The alteration or transformation by natural force or human agency which produces an <i>Event</i> , .e.g... move, sense, communicate, engage, or replenish.



Entities, Actions, Tasks, Interactions: Derived Elements

<i>Role</i>	The function provided by, the part played by, or the character assigned to an <i>Entity</i> .
<i>Actor</i>	The <i>Entity Role</i> -type which takes, executes, conducts, or controls a particular Action.
<i>Supplier</i>	The <i>Entity Role</i> -type which sends, constructs, or produces the input of a particular Action.
<i>Receiver</i>	The <i>Entity Role</i> -type which receives or consumes the output of a particular Action.
<i>Direct-Object</i>	The <i>Entity Role</i> -type which is generated, transformed, or destroyed a particular Action.
<i>Capability</i>	The combination of an <i>Action</i> and a <i>Direct-Object</i> which is recognized as a standard functionality, for example: generate plan, cross river, or shoot missile.



Entities, Actions, Tasks, Interactions: Smallest Unit of Unambiguous Behavior

Entrance Criteria

The set of *States* and the sequence of *Events* which are necessary and sufficient to initiate, begin, restart, or continue *Action* by an *Actor*.

Exit Criteria

The set of *States* and the sequence of *Events* which are necessary and sufficient to terminate, interrupt, end, or conclude *Action* by an *Actor*.

Task

The execution of one or more *Actions* or *Capabilities* by an *Actor*. The *Actor* initiates execution when specific *Entrance Criteria*. During execution the *Action* or *Capability* may receive or consume one or more inputs from *Suppliers*, may produce or deliver to one or more outputs to *Receivers*, and may change one or more *Actor States*. *Task* execution continues until specific *Exit Criteria* are satisfied.

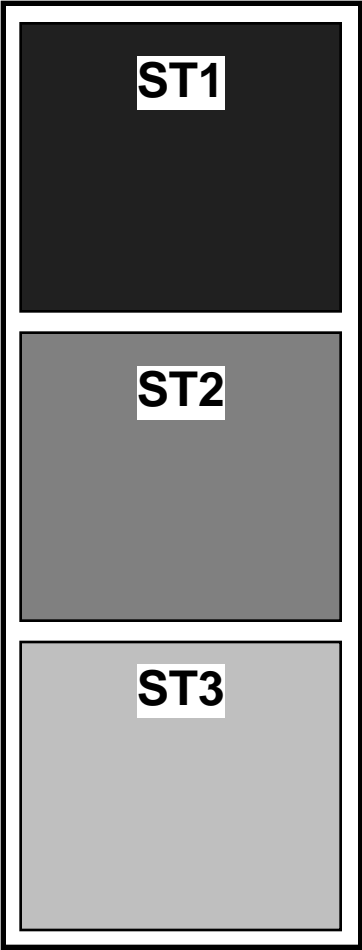
Interaction

The interface which defines the flow of *Events*, *State*, *Entities*, or *Tasks* between two *Entities* or *Tasks*.

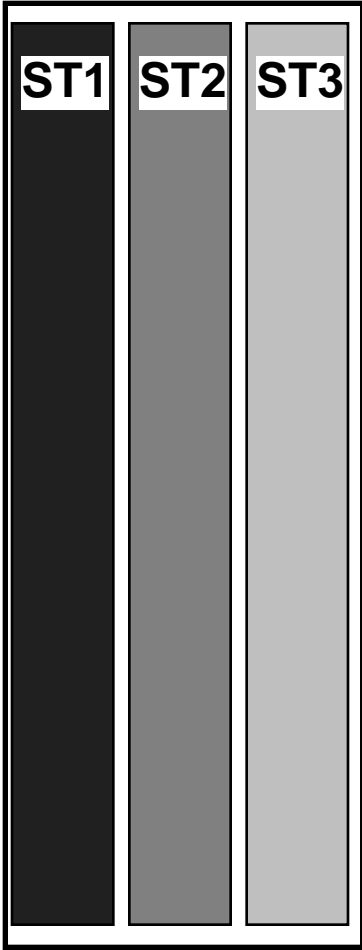


Flexible Sub-Task Structure for EATI

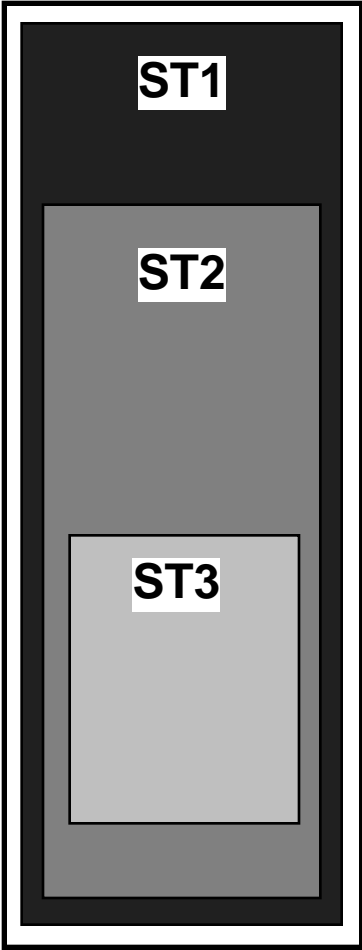
Sequential



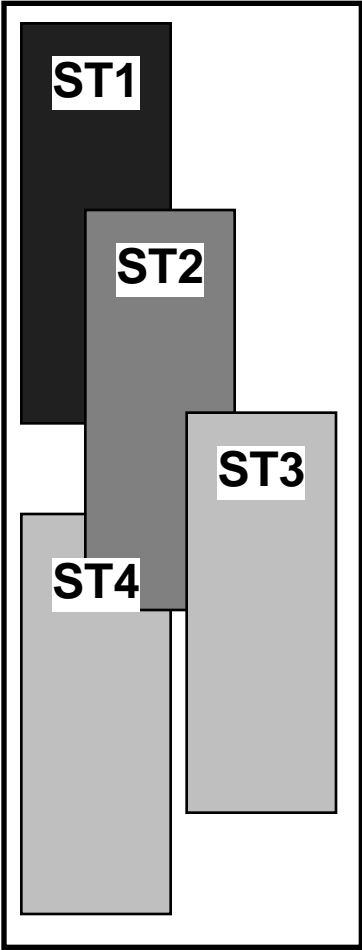
Parallel



Nested



Interleaved





Levels of Warfare Abstraction

	Live Operations	Virtual Simulations	Constructive Simulations
Strategic Level	GCCS	NTF-TBMD	ITEM, CBS, AWS, RESA, ...
Operational Level	JMCIS	JMCIS Training Segment	NSS
Tactical Level	ASW Screen, STW Flight	BFTT, WarSim	OpenSAF
Warfighter Level	Tank, Pilot, Sensor Operator	CCTT, ACTS, EW-OBT,	Ordinance Server, IADS, ...
Physical Level	Lift, Drag, Thrust, Sleep Deprivation, Antennae Pattern	Flight Simulator Sonar Stimulator	JMASS,...